

## EXTERIOR MIRROR

### 5 Background of the Invention

#### 1. Technical Field

The present invention relates generally to a mirror assembly and more particularly to an exterior mirror assembly for a vehicle.

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#### 2. Discussion

Due to constraints for shipping vehicles, especially those for large trucks, mirror assemblies for these vehicles are often times not designed with a heavy emphasis on their appearance or functionality. In shipping vehicles, it is frequently a  
15 constraint that the mirror assemblies can not extend outwardly of any other portion of the vehicle. Accordingly, mirror assemblies were typically designed as flat as possible so that they could be rotated backward to comply with the above shipping constraint.

Construction of the mirror assembly in this manner often resulted in a device  
20 having a generic appearance which did not compliment or accent the appearance of the vehicle in an aesthetically pleasing manner. Furthermore, it was not possible with such designs to utilize the mirror assembly for anything other than housing and supporting a reflective element.

With regard to other vehicle features, while some vehicles provide approach  
25 or other lights in order to illuminate the area around the vehicle, particularly with respect to exterior driver and passenger driver side mirrors, the approach or other lights are typically implemented as one or a number of lights. These lights are typically fixed in orientation so that each light merely performs one function. Because these lights only perform one function, utilizing a number of lights translates  
30 into a substantial cost increase in the mirror assembly. Further, because one or a number of lights may be illuminated at one time, a substantial heat build-up in the air space around the lights limits the heat dissipation. Consequently, an expanded air space must be formed around the lights, which increases the overall size of the mirror design. Further yet, because these lights are fixed, one light can only  
35 illuminate a certain, predetermined area.

In addition, no mirror assembly has provided any type of audio communication between the interior and exterior of the vehicle. Because the vehicles are heavily sound-proofed, occupants typically roll down the window in order to communicate with persons exterior to the vehicle. In some situations, this can present a particular safety hazard when the occupant rolls down the window to speak with potentially dangerous individuals. Further, no mirror assembly has typically provided any type of sound transfer benefit.

### **Summary of the Invention**

It is one object of the present invention to provide a mirror assembly which pivots in a forward direction to retract the mirror housings inward from the edges of the vehicle body.

It is another object of the present invention to provide a mirror assembly which includes a housing assembly having a hinged closure member which covers an accessory cavity.

It is a further object of the present invention to provide a mirror assembly having an accessory attachment point which is adapted to fixedly but reasonably accept a vehicle accessory.

It is yet another object of the present invention to provide a mirror assembly with a resilient bump strip coupled to the mirror housing assembly to prevent scuffing and damage to the mirror assembly when the mirror assembly is brought into contact with an object.

It is a further object of the present invention to provide a mirror assembly having a housing assembly with improved rigidity.

It is yet another object of the present invention to provide a mirror assembly which may be fabricated in a modular manner to incorporate one or more selectively positional mirror orientation mechanisms.

A mirror assembly having a housing assembly, a reflective element, a reflective element adjusting mechanism, an attachment assembly and a wire harness is provided. The housing assembly includes a housing which is filled with a structural foam to improve the rigidity of the mirror assembly, and a scalp which according to one embodiment, may be fixedly but removably coupled to the housing. Alternatively, the scalp may be hingedly coupled to the housing to permit access to a cavity formed therebetween. The cavity may be used for storing various articles,

including a corded light, or may be used to house a switch unit for controlling various vehicle electrical components, such as a vehicle radio or various vehicle lights. A resilient bump strip may be coupled to the housing to protect the housing from scuffing or damage that results from contact with another object.

5           Housing assembly houses the reflective element adjusting mechanism and the reflective element. The attachment assembly is coupled to a vehicle at a first end and to the housing assembly at the second end. The attachment assembly preferably includes a pair of laterally extending arms which may be telescoped between a first and second positions to space the housing assembly further from or  
10 closer to the vehicle. The pair of laterally extending arms are selectively positionable at an operating position, as well as first and second rotational positions. The first rotational position places the housing against the side of the vehicle proximate a side window. Rotation of the arms in a forward direction places into the second rotational position places the housing inward of the sides of the vehicle above the vehicle  
15 fenders or hood.

Additional advantages and features of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings.

## 20    **Brief Description of the Preferred Embodiments**

Figure 1 is a rear perspective view of a portion of a vehicle equipped with a mirror assembly constructed in accordance with the teachings of the present invention;

Figure 2 is a front perspective view of the mirror assembly of Figure 1;

25       Figure 3 is a cross-sectional view of the mirror assembly of Figure 1 illustrating a portion of the first drive mechanism;

Figure 4 is a schematic illustration of a portion of the first drive mechanism;

Figure 5A is an cross-sectional view taken along the line 5A - 5A of Figure 3;

Figure 5B is an cross-sectional view taken along the line 5B - 5B of Figure 3;

30       Figure 5C is an cross-sectional view taken along the line 5C - 5C of Figure 3;

Figure 6 is a cross-sectional view of the mirror assembly of Figure 1 illustrating a portion of the second drive mechanism;

Figure 7 is a top view of a portion of the vehicle of Figure 1 illustrating the mirror assembly in several positions;

Figure 8a is a front perspective of a mirror assembly similar to that of Figure 1 illustrating the incorporation of a turn indicator, an accessory attachment point and a bump strip;

5 Figure 8b is a front perspective of a mirror assembly similar to that of Figure 1 illustrating the incorporation of an antenna attachment point to the sail portion;

Figure 9 is a front perspective of a mirror assembly similar to that of Figure 1 illustrating the incorporation of a marker lamp, a bump strip and a spot light;

Figure 10 is a front perspective of a mirror assembly similar to that of Figure 1 illustrating the incorporation of a spoiler;

10 Figure 11 is a schematic diagram of the mirror assembly of Figure 10 illustrating the function of the spoilers;

Figure 12 is a perspective view of a portion of a mirror assembly similar to that of Figure 1 illustrating the incorporation of a power port into the sail portion;

15 Figure 13 is a perspective front view of a mirror assembly similar to that of Figure 1 but illustrating a hinged scalp;

Figure 14 is a perspective front view of a mirror assembly similar to Figure 13 illustrating a compartment for a corded light;

Figure 15 is a perspective front view of a mirror assembly similar to Figure 13 but illustrating a switching unit;

20 Figure 16 is a perspective rear view of a mirror assembly similar to that of Figure 1 illustrating the incorporation of a speaker into the housing; and

Figure 17A and 17B depicts an exterior, perspective view of a mirror assembly having a displaceable approach light;

Figure 18 depicts a vertical cross-section of the displaceable approach light;

25 Figure 19 is an upward, perspective view of the displaceable approach light;

Figure 20 is a downward perspective view of the displaceable approach light and lens assembly;

Figure 21 is a plan view of a vehicle showing various zones of illumination of the displaceable approach light;

30 Figure 22 is an electrical circuit for operation of displaceable approach light;

Figures 23A and 23B is a perspective view of a mirror assembly having an intercom system;

Figure 24 is a block diagram of the mirror assembly having an intercom system;

Figure 25 is a block diagram of a control system for a mirror assembly having an intercom;

Figure 26 is a schematic diagram showing the sensor activated positioning control;

5        Figure 27 is a detailed perspective view of the mirror sensor of the assembly of Figure 26; and

Figure 28 is a detailed perspective view showing fingerprint sensors in a door handle in accordance with the present invention.

## 10        **Detailed Description of the Preferred Embodiment**

With reference to Figures 1 through 6 of the drawings, a mirror assembly constructed in accordance with the teachings of the present invention is generally indicated by reference numeral 10 and shown in operative association with a vehicle 12. Although the particular vehicle illustrated is a pick-up truck, it will be understood  
15        that the teachings of the present invention have applicability to other types of vehicles, and as such, will not be limited in application to pick-up trucks. Furthermore, although mirror assembly 10 is illustrated and described herein as an exterior drivers side rear view mirror which enables the vehicle operator to view an area beside and rearward of vehicle 12, it will be understood that a passengers side  
20        rear view mirror may be similarly constructed.

Mirror assembly 10 includes a housing assembly 14, a reflective element 16, a reflective element adjusting means (not shown), an attachment assembly 20, a first drive mechanism 22, a second drive mechanism 24 and a wire harness 26. Wire harness 26 couples the vehicle electrical system to each of the various electrical  
25        devices in mirror assembly 10. Housing assembly 14 includes a housing 30 and a scalp 32. Housing 30 is preferably unitarily formed from a molded plastic material and includes a conventional attaching means which is employed to fixedly but removably couple the reflective element adjusting means to housing 30. Housing 30 also houses and supports reflective element 16.

30        With brief reference to Figures 8a and 9, a bump strip 34 formed from a soft and resilient material such as rubber or vinyl, may be included on one or more of the exterior surfaces of housing 30 to prevent housing 30 from being scuffed or damaged in the event that it contacts an object. With specific reference to Figure 8a, bump strip 34 may be contoured or styled in a decorative manner which enhances

the appearance of mirror assembly 10. Bump strip 34 preferably covers the forward most and outward most points of housing 30 to ensure that bump strip 34 rather than housing 30 will contact objects first. Bump strip 34 is preferably coupled to housing 30 and/or scalp 32 via double-sided adhesive tape.

5 Referring back to Figures 1 and 2, scalp 32 is also preferably unitarily formed from a molded plastic material. Preferably, a plurality of conventional snap-fasteners are molded into housing 30 and scalp 32 which permits them to be fixedly but removably coupled to one another without the use of threaded fasteners. Alternatively, scalp 32 may be fixedly coupled to housing 30 with a double-sided  
10 adhesive tape. With additional reference to Figure 3, housing 30 and scalp 32 are shown to cooperate to form a cavity 36 which is completely filled with a structural foam 38. Structural foam 38 is preferably a closed-cell polyurethane foam.

Due to the relative ease with which scalp 32 may be coupled to housing 30, scalp 32 may be configured in a manner which enhances the decorative appearance  
15 of mirror assembly. For example, scalp 32 may be molded from a colored plastic or painted so as to either match or accent the color of vehicle 12. As another example, a decorative design may be molded into the exterior surface 40 of scalp 32.

The reflective element adjusting means is fixedly but removably coupled to housing 30. Preferably, the reflective element adjusting means is an electronically or  
20 manually controlled adjusting mechanism that is well known in the art and which permits the position of the reflective element 16 to adjusted from the passenger compartment of vehicle 12. Alternatively, the reflective element adjusting means is a manually controlled adjusting mechanism that is well known in the art which is actuated by a force directed to reflective element 16.

25 Reflective element 16 is preferably fixedly but removably coupled to the reflective element adjusting means, and as such is selectively positionable relative to housing 30. In the preferred embodiments of the present invention, reflective element 16 is fabricated from mirror glass which may be heated and/or may include other characteristics such as electrochromic properties and hydrophobic or  
30 hydrophilic coatings. Reflective element 16 may also be constructed in a manner which permits it to be readily removed from the reflective element adjusting means for servicing of mirror assembly 10 and/or and replacement of reflective element 16.

Housing assembly 14 is coupled to attachment assembly 20. In the particular embodiment illustrated, attachment assembly 20 includes a sail portion 50, first and

second arms 52 and 54, respectively, and an approach light 56. Sail portion 50 is attached to vehicle 12 via threaded posts or other conventional connectors. A seal is typically interposed between sail portion 50 and vehicle 12 to isolate the interior of vehicle 12 from moisture, dirt and noise.

5 Each of the first and second arms 52 and 54 include a first laterally extending structure 60 and a second laterally extending structure 62. The first and second laterally extending structures 60 and 62 may be moved in an axial direction relative to one another to permit first and second arms 52 and 54 to telescope inwardly toward vehicle 12 or outwardly therefrom. In the particular embodiment illustrated,  
10 first laterally extending structure 60 is fixedly coupled to housing assembly 14 and second laterally extending structure 62 is coupled to sail portion 50.

With reference to Figure 3, each of the first laterally extending structures 60 preferably includes a first cover member 70 and a first tubular member 72 and each of the second laterally extending structures 62 includes a second cover member 74  
15 and a second tubular member 76. The first and second tubular members 72 and 76 are preferably formed at least partially from a square or rectangular tubing.

First tubular member 72 is sized to slidably receive second tubular member 76. The interior surface of second cover member 74 is spaced apart from second tubular member 76 to permit sliding engagement between first and second tubular  
20 members 72 and 76. The interior surface of first cover member 70 is spaced apart from first tubular member 72 to permit sliding engagement between first and second cover members 70 and 74. As the function of the first and second cover members 70 and 74 is primarily cosmetic, they may have cross-sections that are round, square, rectangular, elliptical or any other desired shape.

25 Each of the second laterally extending structures 62 is disposed at least partially within a respective first laterally extending structure 60. The first and second laterally extending structures 60 and 62 may be moved in an axial direction relative to one another to permit first and second arms 52 and 54 to telescope inwardly toward vehicle 12 or outwardly therefrom. A pair of first rollers 80 are  
30 coupled to second tubular member 76 and extend through slots 82 formed in its rear sidewall 84. First rollers 80 are journally supported by a pin 86 for rotation about an axes that are perpendicular to the axis of the first and second arms 52 and 54. A second roller 90 is coupled to an opposite side of second tubular member 76 and extends through a slot 92 formed in its front sidewall 94. Second roller 90 is also

journally supported by a pin 96 for rotation about another axis that is perpendicular to the axis of the first and second arms 52 and 54. Pin 96 is disposed in a slot 98 formed in second tubular member 76. A spring 100 is coupled to second tubular member 76 and is operable for urging pin 96 in a direction away from the first rollers 80 and against the inner surface of the first tubular member 72. Each set of first and second rollers 80 and 90 cooperate to control relative movement between the first and second laterally extending structures 60 and 62 in non-axial directions. Structural foam 38 retains first laterally extending structure 60 to housing assembly 14 while providing structural support to inhibit the flexing of the first and second arms 52 and 54 relative to one another.

First drive mechanism 22 is operable for telescoping first and second arms 52 and 54 between an extended position and a retracted position. First drive mechanism 22 may be configured in a manner similar to that disclosed in commonly assigned Australian Provisional Patent Application Serial No. PP8619 filed February 9, 1999 entitled "Means For Extending Or Retracting Telescopic Tubes", which is hereby incorporated by reference as if fully set forth herein.

Alternatively, as shown in Figure 3 through 5C, first drive mechanism 22 is illustrated as including a motor assembly 110, an intermediate worm structure 112 and upper and lower worm structures 114 and 116. Motor assembly 110 includes a conventional reversible dc motor 120 and a drive worm 122 which is coupled for rotation with the output shaft of motor 120. The housing of motor 120 is fixedly coupled to housing assembly and the output shaft of motor 120 is oriented along an axis parallel to the axes of the first and second arms 52 and 54.

Intermediate worm structure 112 includes an intermediate worm gear 126 and first and second intermediate worm drives 128 and 130. Intermediate worm structure 112 is coupled to housing assembly 14 for rotation about an axis perpendicular to the axis of the output shaft of motor 120 such that intermediate worm gear 126 meshingly engages drive worm 122.

Upper and lower worm structures 114 and 116 are similar in construction, and as such, only upper worm structure 114 will be discussed in detail. Upper worm structure 114 includes a worm gear 136, a lead screw 138 and a drive member 140. Worm gear 136 meshingly engages first intermediate worm drive 128. A ball bearing 144 and a preload spring assembly 146 cooperate to align worm gear 136 to first intermediate worm drive 128. Worm gear 136 and lead screw 138 are coupled for



rotation with one another. Lead screw 138 includes an externally threaded surface 148 which is rotatably supported by first tubular member 72 along the axis parallel to the axis of first arm 52. Drive member 140 includes an internally threaded surface (not shown) which meshingly engages the externally threaded surface 148 of lead screw 138. Drive member 140 is fixedly coupled to the upper and lower surfaces of second tubular member 76.

Rotation of the output shaft of motor 120 therefore causes lead screws 138 to rotate in a corresponding direction which exerts a force onto the drive members 140 to cause the first tubular members 72 to telescope inwardly to or outwardly from their corresponding second tubular members 76.

Second drive mechanism 24 is illustrated in Figure 6 as including a drive and clutch system 160 which are similar to the drive and clutch system disclosed in commonly assigned co-pending U.S. Patent Application Serial No. 09/085,708 entitled "Mirror Parking System", which is hereby incorporated by reference as if fully set forth herein. Accordingly, this aspect of mirror assembly 10 will not be discussed in detail, other than noting that a powered worm 162 meshingly engages a worm gear 164. newly

Unlike the above reference drive mechanism, second drive mechanism 24 is shown to include a shaft 170 which is fixed for rotation with worm gear 164. First and second pinions 172 and 174, respectively, are coupled to either end of shaft 170 and fixed for rotation thereon. First and second pinions 172 and 174 are meshingly engaged with a respective drive gear 176 which is supported for rotation about a pivot pin 178. Drive gear 176a is coupled for rotation with first arm 52 and drive gear 176b is coupled for rotation with second arm 54. Accordingly, rotation of powered worm 162 is operable for rotating shaft 170 to cause first and second arms 52 and 54 to rotate simultaneously in a desired direction.

First and second drive mechanisms 22 and 24 may be coupled to a programmable controller 200 which permits the vehicle operator to store a given mirror orientation to memory. The mirror orientation may include information on the position of reflective element 16, as well as the telescopic and rotational positions of housing assembly 14 relative to sail portion 50. Retrieval of the stored mirror orientation causes controller to actuate the first and second drive mechanisms 22 and 24, and the reflective element adjusting means as necessary to adjust the reflective element to the stored mirror orientation.

Alternatively, one or both of the power drive mechanisms may be omitted completely thereby rendering mirror assembly 10 fixing the position of housing assembly 14 relative to vehicle 12. Also alternatively, one or both of the power drive mechanisms may be omitted with a manually actuated mechanism substituted therefor. To control the telescoping movement, a plurality of friction shoes are incorporated into the first and second arms 52 and 54 to provide resistance to their telescopic movement during the operation of vehicle 12. Similarly, to control rotational movement of housing assembly 14, attachment assembly 20 may be fitted with a detents mechanism having a plurality of detents which fixedly but reasonably restrain first and second arms 52 and 54 in a desired orientation.

As illustrated in Figure 7, mirror assembly 10 is selectively positionable between a rearward retracted position 190, an operational position 192 and a forward-retracted position 194. Mirror assembly 10 is conventionally maintained in the operational position 192 until such time as vehicle 12 is required to approach an object near one or more of its lateral sides. At such time, mirror assembly 10 may then be rotated forward or rearward. Placement of mirror assembly 10 into the rearward retracted position 190 positions housing assembly 14 against the lateral side of vehicle 12 such that housing assembly 14 is proximate the side window. Positioning mirror assembly 10 in this manner may be best suited where vehicle 12 is being operated in a forward direction and it is desirable to protect the mirror assembly from forward impacts, such as when traveling through overgrown trails. This position, however, tends to interfere with the vehicle occupant's ability to move their hands or see through the side window of vehicle, as when at automatic teller machines or the drive-through windows of fast-food restaurants.

In situations such as this, mirror assembly 10 may advantageously be oriented to its forward-rotated position 194 to substantially clear the area proximate the side window of the vehicle 12. This position is also advantageous in that the housing assembly 14 is positioned substantially inward of the lateral side of vehicle 12, thereby permitting housing assembly 14 to be relatively deep in comparison to similar mirrors which can only be rotated to a rearward rotated position 190. Consequently, housing 30 and scalp 32 need not be designed in a relatively flat manner, but may be extended to address aesthetic and aerodynamic issues.

Returning to Figures 1 and 2, approach light 56 includes a controller 200, a reflector housing 202 and a lens 204 and a plurality of lamps 206. Illumination of

lamp 206a causes an area adjacent vehicle 12 and forward of mirror assembly 10 to be illuminated. Illumination of lamp 206b causes an area adjacent vehicle 12 and below mirror assembly to be illuminated. Illumination of lamp 206c causes an area adjacent vehicle 12 and rearward of mirror assembly 10 to be illuminated.

- 5 Illumination of lamp 206d causes an area lateral to mirror assembly 10 to be illuminated. Controller 200 is operable for selectively illuminating one or more of the lamps 206 upon the occurrence of a predetermined condition. For example, actuation of a remote keyless entry device or a power lock switch on one of the vehicle doors causes all of the lamps to illuminate so as to illuminate an area around
- 10 vehicle 12 to aid in the ingress to and egress from vehicle 12. Actuation of the vehicle turn signal lever to turn left, for example, causes lamp 206a to illuminate to provide the vehicle operator with an illuminated view of the area to which vehicle 12 is being turned. Placement of the vehicle gear selector into a reverse gear ratio causes lamp 206c to illuminate, providing the vehicle operator with an illuminated
- 15 view of an area to the side and behind vehicle 12. Controller 200 preferably includes a remote light switch 208 which permits one or more of the lamps 206 to be illuminated as desired.

- Alternatively, approach light 56 may be configured in a manner similar to that disclosed in commonly assigned U.S. Provisional Patent to Andrew J. Assinder
- 20 entitled "Exterior Mirror Having An Attachment Member Including An Approach Light" which is hereby incorporated by reference as if fully set forth herein.

- Other light devices may similarly be incorporated into mirror assembly 10, either in addition to approach light 56 or in substitution thereof. A first example is illustrated in Figure 8 where a turn indicator 210 is shown coupled to housing 30.
- 25 Turn indicator 210 may be placed on mirror assembly 10 so as to face in a rearward direction, a sideward direction or both a rearward and a sideward direction. Turn indicator 210 is conventional in its operation in that its actuation is controlled by the vehicle turn signal lever.

- A second example is illustrated in Figure 9 where a side marker 212 is
- 30 coupled to housing 30. Side marker 212 may be conventionally operated to illuminate when the vehicle parking lights or vehicle head lights are illuminated. Side marker 212 may also be operated to illuminate when vehicle 12 is locked or unlocked and thereafter turned off when vehicle 12 is started or after a predetermined time.

A third example is further illustrated in Figure 9 wherein mirror assembly 10 is shown to include a spot light 214. Spot light 214 is movably coupled to attachment assembly 20 and located between the first and second arms 52 and 54. Spot light 214 includes a first portion 216 which is fixedly coupled to scalp 50 and a second portion 218 which is selectively positionable relative to first portion 216 via a control mechanism (not shown) which is preferably actuatable from the interior of vehicle 12. The control mechanism may be a manual handle or may be electronically controlled. Preferably, the second portion is gimbaled to the first portion, permitting second portion 218 to focus light in a predetermined area.

Attachment assembly 20 may also be fitted with various other accessories, such as a spoiler. In Figure 10, attachment assembly 20 is shown to be fitted with a first spoiler 230 and a second spoiler 232. First spoiler 230 is coupled to the first laterally extending structures 60 so as to be fixed in relation to housing 30. Second spoiler 232 is coupled to the second laterally extending structures 62 so as to be fixed in relation to the vehicle side window. As shown in Figure 11, first spoiler 230 is configured to deflect a first air flow 236 across reflective element 16 to clear its exterior surface of water and/or contamination. Similarly, second spoiler 232 is configured to deflect a second air flow 238 across the side window to clear it of water and/or contamination. First and second spoilers 230 and 232 may be integrally formed into housing 30 and sail portion 50, respectively, or may separately manufactured permitting them to be supplied to consumers as an after-market product.

An accessory attachment point 240 may be provided in attachment assembly 20 or housing assembly 14. As illustrated in Figure 8a, accessory attachment point 240 is integrated into sail portion 50 and permits various accessories, such as flags 242 and pennants of various collegiate or professional sports teams to be fixedly but removably coupled to mirror assembly 10.

Similarly, as illustrated in Figure 8b, an antenna attachment point 246 may also be integrated into mirror assembly 10. Antenna attachment point 246 permits an antenna 248 for one or more of the vehicle radio, a wireless phone and a remote keyless entry device to be coupled to mirror assembly 10. This embodiment is advantageous in that it provides an antenna connection for the desired device without forming a hole in the sheet metal body of vehicle 12. Alternatively, as shown in Figure 16, antenna 248 may be completely disposed within cavity 36 in housing

assembly 14. In the particular embodiment illustrated, antenna 248a is coupled to the vehicle radio, antenna 248b is coupled to a wireless phone and antenna 248c is operable for receiving a remote unlocking/locking signal which is typically generated by a remote keyless entry device.

5           As illustrated in Figure 12, another feature that may be integrated into mirror assembly 10 is a power port 250 which uses the electrical system of vehicle 12 to power various accessories, such as hand-held spot lights. A plug assembly 252 having a resilient seal 254 is used to close the cavity of power port 250 to prevent infiltration of water and dirt therein.

10           Figures 13 through 15 illustrate yet another alternative construction of mirror assembly 10. Scalp 32 is shown to be hingedly coupled to housing 30, permitting scalp 32 to be pivoted between a closed position substantially closing the open end of housing 30, and an open position substantially clearing the open end of housing 30. A cavity 260 is formed between scalp 32 and housing 30 which may be used to  
15           conceal a power port 250 or to store various items, such as replacement lamps 262, fuses 264 and/or tools such as a pressure gauge 266 and screwdrivers 268. A lock mechanism 270 is incorporated into scalp 32 which is positionable in a locked condition inhibiting the movement of scalp 32 from the closed position to the open position, and an unlocked condition permitting the movement of scalp 32 from the  
20           closed position to the open position.

          As illustrated in Figure 14, cavity 260 may be used for storing a corded lamp 280. Corded lamp 280 includes a housing 282, a lens 284, a lamp 286 and a cord portion 288. Cord portion 288 is electrically coupled to the electrical system of vehicle 12, permitting corded lamp 280 to be moved relative to mirror assembly 10 to  
25           provide light to a remote area, as when changing a tire or when examining the engine compartment or bottom side of vehicle 12.

          As illustrated in Figure 15, a switching unit 290 may additionally or alternatively be placed into cavity 260. Switching unit 290 is coupled to various vehicle electrical devices to permit them to be remotely controlled from outside  
30           vehicle 12. In the example provided, switching unit 290 includes a set of first controls 292 which are operable for remotely controlling the vehicle radio and a set of second controls 294 which are operable for remotely controlling various vehicle lights. First controls 292 may be actuated to turn the vehicle radio on or off, select a signal medium (e.g., radio signal, cassette tape, compact disc) or adjust various

settings such as playback volume, balance, tone. Preferably, first controls 292 are identical in configuration and function to any controls for the vehicle radio which are contained in the vehicle interior. Second controls 294 includes a plurality of switches which may be actuated, either individually or in combination, to illuminate various vehicle lamps. Second controls 294 permits, for example, the vehicle hazard lights to be actuated from the exterior of vehicle 12 as well as an auxiliary light to be illuminated to permit an area of vehicle 12 to be illuminated, as when changing a tire.

One or more audio speakers may also be integrated into mirror assembly 10. As illustrated in Figure 16, an audio speaker 300 is integrated into housing 30. Audio speaker 300 may be coupled to the vehicle radio to permit the playback of music and other programs outside of vehicle 12. Audio speaker 300 may additionally or alternatively be coupled to a microphone inside vehicle 12, permitting the vehicle occupants to broadcast messages to persons outside vehicle 12. Audio speaker 300 may additionally or alternatively be configured as a siren to produce a warning signal to alert persons to the presence of vehicle 12. Also alternatively, audio speaker 300 may be integrated into attachment assembly 20 in sail portion 50 or to a bracket (not shown) which is coupled to first and second arms 52 and 54.

As discussed above, it is often desirable to provide a single approach light which is displaceable in order to fully illuminate a desired area around the vehicle.

Figs. 17-21 show a mirror assembly 410 arranged in accordance with the principles of the present invention. Mirror assembly 410 is substantially arranged as described above with respect to Figs. 1-16 and can incorporate any of the features as described with respect to Figs. 1-16. In general, mirror assembly 410 attaches to vehicle 412. Mirror assembly 410 includes a housing assembly 414, a reflective element (not shown), a reflective element adjusting means (not shown), and an attachment assembly 420. Housing assembly 414 includes a housing 416 and an optional scalp 418. Housing 416 is preferably formed as described above. Housing 416 also houses and supports the reflective element. As mentioned, mirror assembly 410 can include any or all of the features described above with respect to Figs. 1-16.

A particular aspect of this invention will be described with respect to Figs. 17-20. Mirror assembly 410 includes an adjustable approach light assembly 422. Approach light assembly 422 is embodied as a single approach light which is adjustable in order to illuminate various areas with respect to the vehicle. With

reference to Figs. 18-20, approach light assembly 422 is integrally formed with attachment assembly 420. Approach light assembly 422 includes a housing 424 formed within attachment assembly 420. Housing 424 supports upper post 426 and lower post 428. Reflector 430 includes upper mounting tab 432 and lower mounting tab 434. Upper mounting tab 432 and lower mounting tab 434 attach to respective posts 426, 428, and define a pivot axis for reflector 430.

Reflector 430 supports a light source 436, such as an incandescent bulb or light emitting diode (LED). Light from light source 436 reflects off reflector 430 and is projected generally outwardly away from the vehicle through optical lens element 438 and transparent cover 440. In a particular feature of the present invention, lens 438 may be incorporated integrally with cover 440 to define a unitary lens/cover assembly. Lens 438 also may provide different optical outputs depending upon the rotational position of reflector 430.

Spotter light assembly 422 also includes a drive system 446. Drive system 446 includes a drive motor 448. Drive motor 448 displaces an output member 450 which engages, either directly or indirectly, reflector 430 in order to rotate reflector 430 about the pivot axis defined by upper and lower mounting tabs 332, 334. Drive member 450 may be embodied as a belt and pulley, gear, or other mechanical interconnection system. It should be recognized that a similar drive system to drive system 448 may be arranged to enable rotational movement about a horizontal axis in order to provide both horizontal and vertical movement of reflector 430, thereby further enhancing the scope coverage of approach light assembly 422.

Fig. 21 depicts a plan view of vehicle 412 and mirror assembly 410. Fig. 21 is particularly adapted to show various zones of coverage of displaceable approach light assembly 422. Approach light assembly 422 covers a first zone, zone 1, which may generally be described as a forward zone having a 30 degrees sweep and a two meter range. Approach light assembly 422 also covers a second zone, zone 2, in which approach light assembly 422 acts as an adjustable light to provide an overall sweep of 120 degrees and six meters distance from the vehicle. Approach light assembly 422 also includes a third zone, zone three, which may be utilized during reversing maneuvers and covers a thirty degree sweep and a four meter distance from mirror assembly 410. A fourth zone, zone four operates as an approach light providing a zone in close proximity to the vehicle having a longitudinal length of two

meter and a transverse length of approximately one meter with respect to mirror assembly 410.

Fig. 22 is a block diagram of a control circuit 456 for operating approach light assembly 422. In particular, controller 458 receives several inputs and motor commands to one or a pair of motors 460 and 462. For example, motor 460 may be embodied as a horizontal displacement motor, and motor 462 may be embodied as a vertical displacement motor. Controller 458 receives input from several sensors, including a turn indicator sensor 464, a approach light control sensor 466, a shift select sensor 468, a lock sensor 470, and a FOB tracker sensor 472. The sensors 464-472 provide input signals to controller 458 which then generates motor control commands output to motors 460, 462.

The sensors 464-472 and controller 458 cooperate to select several modes of operation. In the first mode of operation, approach light assembly 422 illuminates the front and side of the vehicle, zone 1, during turning maneuvers. In this position, approach light assembly 422 shields light from oncoming drivers by directing it downward. Such positioning of approach light assembly 422 can occur automatically by sensing activation of a turns signal through turn signal sensor 464. In a second mode of operation, approach light assembly 422 illuminates zone 2 as described in Fig. 21. Because approach light assembly may be displaced to fully cover zone 2, such displacement may be manually or remotely controlled. Accordingly, spot controller 466 enables the vehicle occupant to manually displace approach light assembly 422 by providing control commands to controller 458 which in turn generates control commands to motors 460, 462.

In a third mode of operation, approach light assembly illuminates zone 3, such as may occur during reversing maneuvers. Shift sensor select 468 detects reverse positioning of the shift selector and generates a signal to controller 458, causing motors 460, 462 to direct approach light 422 to cover zone 3.

Approach light assembly 422 includes a fourth mode of operation for covering zone 4 by reflecting a portion of light down from a forward turn position, such as for zone 1, or an auxiliary position when the remote unlock position is actuated by an approaching driver. Accordingly, lock sensor 470 provides an input to controller 458 for determining the position of vehicle locks 470. Further, sensor 470 may also detect input from a key FOB to cause approach light assembly 422 to cover zone 4 on activation by an approaching driver.



In a fifth mode of operation, a FOB tracker sensor 472 detects activation of the remote keyless entry system and tracks the position of a FOB. FOB tracker 472 outputs signals to controller 458 to enable motors 460, 462 to displace approach light assembly 422 so as to continuously track the key FOB. Such a feature effectively provides a constant illumination for an individual approaching a vehicle 412 with a key FOB.

The system of Figs. 17-22 provides several advantages over multi-light systems. Particularly, only one light source is used instead of three or four. The approach light is adjusted by mechanical means by performing different functions and by passing through different, position-specific optics and pointing in different positions. This reduces the overall costs of the assembly. The subject invention also increases the worst case heat tolerance because only one light at a time can be illuminated, rather than the four lights that can be illuminated in multi-light systems. Thus, the air space and the surface area of the entire space is available for heat dissipation of merely one light. Such a feature enables a more compact design to be implemented, and enables a greater intensity of light output over a multiple-light system. Further, the manually adjustable feature enables flexibility and lighting a variety of objects within the adjustment range of the approach light assembly.

Fig. 23 depicts mirror assembly 480 arranged in accordance with the principles of yet another embodiment of the present invention. Mirror assembly 480 attaches to a vehicle 482. Mirror assembly 480 is generally as described above with respect to Figs. 1-22 and can include one or all of the above-described features. In particular, mirror assembly 480 includes a housing assembly 484 and an attachment assembly 486 for attaching mirror assembly 480 to mirror 482. Housing assembly 484 includes a housing 488 which supports reflective elements 490, 492. As mentioned, mirror assembly 480 may incorporate one or all of the features of the design embodiments of Figs. 1-22.

Mirror assembly 480 is particularly directed to disclosing an intercom system 494 which facilitates communication between the vehicle interior and exterior when the vehicle doors are closed and the windows are closed as well. As shown in Fig. 24, in the most basic embodiment, intercom system 494 includes a microphone 496 which receives audio input sound and generates electrical signals into mirror assembly/intercom 498. Mirror assembly/intercom 498 is configured within attachment assembly 486 so that a portion of intercom system 494 resides within the

vehicle 482 and a portion resides exterior to the vehicle 482. Mirror assembly/intercom 498 with respect to the intercom, operates as a conventional intercom, many of which are known in the art. Mirror/intercom assembly 498 generates an output signal to speaker 500 which generates an audio output. As shown in Fig. 24, a switch 502 may be used to activate and deactivate system 494. Alternatively, a voice activated system can be used to eliminate switch 502.

Fig. 25 depicts a block diagram of an intercom control system 506. Intercom control system 506 includes a controller/intercom 508 which receives a number of input signals. The signals are generated by one or a plurality of electrical sensors. In particular, a door/window sensor 510 generates a signal indicating whether the vehicle doors or windows, particularly in proximity to intercom system 594, are open or closed. A shift select lever 512 generates an input signal to controller/intercom 508 in accordance with the position of a shift select lever. A microphone 514 operates as a conventional microphone and converts audio signals into electrical signals which are input to controller/intercom 508. A manual switch 516 operates as manual switch 502 as described with respect to Fig. 24. In particular, intercom control system 506 may be voice operated or may alternatively be manually operated. Manual switch 516 enables operation of the intercom. A warning sensor 522 connects to other vehicle systems and generates signals in accordance with various system warnings, such as low battery, keys left in car, door open or unlocked. A cell phone input 524 provides an electrical signal to enable exterior broadcasting of a cell phone conversation.

Controller/intercom 508 receives the input signals and generates an electrical signal to speaker 518 to generate acoustic output.

With reference to Fig. 25, several features of intercom control system 506 will be described. In particular, intercom control system 506 implements an interlock circuit in controller/intercom 508 which operates in conjunction with the position of the vehicle doors and windows as output by doors/window sensor 510. If a door or window is open, controller/intercom 508 can disable the intercom system completely or utilize circuitry to eliminate or reduce feedback while the door or window is open.

In another feature of the present invention, shift select sensor 512 can generate an output signal to controller/intercom 508 to indicate a vehicle reverse mode. In such a mode, controller/intercom 508 may generate a buzzer, beeper, or other signaling tone to warn of an impending vehicle reverse. Further, the intercom

can be tied to and operate in conjunction with an approach light 520 to provide some audible output upon activation of the approach light as an added security feature.

Referring now to Figures 26-27, there is illustrated a further feature of the present invention. As seen in Figure 26, a vehicle interior generally shown at 600 includes power adjustable seat bottom 602, power adjustable seat back 604, power adjustable head rest 606, power adjustable steering counsel 608, power adjustable side view mirror 610, and power adjustable pedals 612. An audio sensor 614 may be provided in the mirror 610 for sensing the approach of a specific individual. While sensor 614 is shown in the said attachment portion, the sensor is alternatively positioned in the mirror housing itself. Each of the components, 608, 606, 604, 602 and 610, are connected to memory module in the vehicle for at least changing one of the positions to a predetermined position, which is based on the previously programmed position of an occupant or user of the vehicle.

A control module 616 is connected to the control of each of these components to provide adjustment of an interior component, such as a seatback, a seat bottom, and the like, for response to individualist input received by the sensor 614. The controller has a memory feature wherein one or a plurality of individual positions of the power adjustable components is stored. This allows individual drivers or passengers to have the seat, pedal or other components returned to the desired position. Such systems are known in the art and used in luxury vehicles. As set forth above, the sensor may be a voice recognition-type sensor, which acts in conjunction with the controller to provide predetermined memory positions for the driver or passenger whose individual voice is used for opening the vehicle. In an alternate embodiment, shown in Figure 27, a sensor (or plurality of sensors) 618 may be provided in the door handle 620 or the like. The sensor utilizes a receiver having individualistic frequency, such as a ring transmitter. The transmitter emits an individualistic code when in close proximity, resets all of the positioning components in the vehicle to the sensor. Alternatively, the sensor could be a fingerprint-type sensor which immediately scans the fingerprint of the user and provide the individualistic settings which have been preset for that user. As will be readily appreciated by those skilled in the art, other individualistic coated sensors may be utilized to provide the individualistic positioning of the stored positions for a particular user of the vehicle.

While the invention has been described in the specification and illustrated in the drawings with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention as defined herein. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment illustrated by the drawings and described in the specification as the best mode presently contemplated for carrying out this invention.